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A cross-sectional study on working hours, sleep duration and depressive symptoms in Japanese shift workers

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日本の交代勤務者における労働時間，睡眠時間とうつ症状に関する横断的研究

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Objectives: Shift work is reported to increase risk for various health problems including depression. The purposes of this study are to analyze whether working schedule (day work vs. shift work) may affect depressive symptoms.

Methods: To examine these, we performed a cross-sectional study using questionnaires in a pharmaceutical company in Japan (n = 1,893). We extracted data from the intranet database of the employee including age, sex, type of job, work schedule (day work/shift work, average overtime hours per one month), sleep duration, drinking frequency, current smoking, exercise habits, and depressive symptoms. Depressive symptoms were assessed using the Patient Health Questionnaire-2 (PHQ-2).

Results: The number of daytime workers and shift workers were 1,684 (89.0%) and 209 (11.0%), respectively. Multiple logistic regression analysis revealed that shift work (odds ratio = 2.01, 95% confidence intervals: 1.45-2.79, $p < 0.0001$), long working hours (odds ratio = 1.40, 95% confidence intervals: 1.03-1.89, $p = 0.03$), and short sleep duration (odds ratio = 2.01, 95% confidence intervals: 1.54-2.63, $p < 0.0001$) were independent risk factors for depressive symptoms.

Conclusions: This study revealed that shift work raised the risk of depressive symptoms independent of short sleep duration (< 5 hours) and long working hours.

Key words: Shift work, short sleep duration, long working hours, depression, epidemiology
（交代勤務，短時間睡眠，長時間労働，うつ，疫学）

Introduction

The health problem by shift work is clear by the previous study, and depression and sleep disorder was called one of them[1]. However, shift work serves as a working style, which is practically difficult to avoid at the manufacturing industry in modern times. The employees who suffered from depression had been increasing in Japan[2], and it has had a great influence on labor productivity. Depression has been reported to be related to various factors, such as work environment and lifestyle[3-6], female gender[7], characterological tendencies[8], work stress[9], stressful life events[10], and changes in the work environment[11]. It is reported that depression is more frequent in shift workers than in daytime workers[3].

Shift workers differ in the timing of working and sleeping hours compared to daytime workers. Therefore, we hypothesized that these factors were related to depressive symptoms.

The purpose of this study was to analyze whether working schedule (day work vs. shift work) may affect depressive symptoms. We plan to utilize the outcome of

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this study to minimize health problem for workers. We performed a cross-sectional study using a questionnaire about working hours, sleep duration, lifestyle, mental health, and physical health in daytime workers and shift workers in a Japanese company.

Subjects and Methods

Subjects

The subjects of this study were employees of a pharmaceutical company in Japan (n = 1,992; male: 75.2%; age: 21–64 years). Data were obtained through self-report questionnaires, comprised of 62 items such as age, sex, health condition, lifestyle, and work environment, administered using a company intranet in 2011. 55 males and 44 females were absented from work because of maternal leave, childcare leave or other medical problems, and we were not included in the study. Informed consent was obtained from all of the participants (participation rate of 95.0%). This survey was performed as a part of annual health checkup in the company, and all the participants agreed to use the information in this study. The study protocol was reviewed and approved by the ethics committee of the Shiga University of Medical Science (No. 23-67-1).

Questionnaire

We extracted data from the intranet database of the employee including sex, age, type of job, work schedule (day work/shift work, average overtime hours per one month), sleep duration, drinking frequency, current smoking, exercise habits, and depressive symptoms.

All workers worked for 7.75 hours per day. All the workers worked 5 days per week, and had 2 holidays per week. Some shift workers worked with two shifts without night work, and the others worked with three shifts including night work shift. We did not ask whether we took two shifts or three shifts in the questionnaire.

Total working hours were asked and "≥200 hours/month" was defined as "long working hours" at this time. Daily work of more than about 8 hours was considered as long working hours. Regular working duration was 7.75 hours per day in this company. To work more than 8 hours, workers are required to have 0.25-hour break.

Overtime work was asked as 0-20, 20-45, 45-60, 60-80, 80-100 and >=100 hours. These categories mean total working hours of 155-175, 175-200, 200-215, 215-235, 235-255 and >= 255 hours, respectively.

Sleep duration was asked as < 4, 4-5, 5-6, 6-7, 7-8 and >= 8 hours. For sleep duration, "≥5 hours" was classified as "normal sleep" and "<5 hours" as "short sleep" because Itani et al. reported that sleep duration of less than 5 hours was a risk factor for poor health in Japanese workers[4].

Frequency of alcohol consumption during the previous year was asked (*almost every day, three or four times a week, once or twice a week, three or four times a month, once or twice a month,* or *do not drink*). Subjects who answered "almost every day" were considered frequency drinkers.

Depressive symptoms were assessed by two items of PHQ-9 (PHQ-2: two-item scale of the Patient Health Questionnaire). The PHQ-2 asked frequency of "little interest or pleasure in doing things" and "feeling down, depressed, or hopeless" during the past two weeks (*not at all, several days, more than half the days, or nearly every day*). The PHQ-2 was reported to be effective for screening depression[11–15]. Items are rated on a 4-point Likert scale with a total score of 0 to 6 for the PHQ-2. The cutoff point was three or more points. Because sensitivity and specificity of the PHQ-2 for diagnosing major depression were 61% and 92% with a score 3 or higher[14]. Three or more points were considered as depressive symptoms.

Statistical analysis

Categorical data were presented as proportions, and continuous data were presented as means and standard deviations (SD). Categorical variables were analyzed with the chi-square test, Fisher's exact test, and continuous variables were analyzed with t test.

A multivariate logistic regression model was constructed to examine the independent associations of the important covariates: working schedule (day work vs. shift work), sex (male vs. female), age (one year increment), long working hours (<200 hours vs. ≥200 hours), sleep duration (<5 hours vs. ≥5 hours), frequent drinkers (yes vs. no), current smoking (yes vs. no), exercise (≥once a week vs. <once a week), and depressive symptom (yes vs. no). The dependent variable of this model was depressive symptom.

All statistical analyses performed by SPSS 20 for Windows (IBM Corp. Armonk, NY). Statistical significance was defined as a p value less than 0.05.

Results

The number of daytime workers was 1,684 (89.0%) and that of shift workers was 209 (11.0%). Demographics of daytime workers and shift workers are presented in **Table 1**. Daytime workers were older and spent more time

Table 1 Demographics of daytime workers and shift workers

	Total n (%)	Daytime workers	Shift workers	p-value
Sex				
Males	1,443 (76.2)	1,290	153	0.28 [c]
Females	450 (23.8)	394	56	
Age				
20 – 29 years	286 (15.1)	251	35	< 0.001 [c]
30 – 39 years	651 (34.4)	529	122	
40 – 49 years	675 (35.6)	631	44	
≥ 50 years	281 (14.9)	273	8	
Age, years, mean ± SD	39.7 ± 9.0	40.2 ± 9.1	36.1 ± 7.1	<0.001 [d]
Long working hours				
< 200 hours/month	1,613 (85.2)	1,406	207	<0.001 [e]
≥ 200 hours/month	280 (14.8)	278	2	
Sleep duration				
< 5 hours/day	317 (16.8)	285	32	0.56 [c]
≥ 5 hours/day	1,576 (83.2)	1,399	177	
Frequency drinking [a]				
No	1,515 (80.0)	1,340	175	0.16 [c]
Yes	378 (20.0)	344	34	
Smoking				
No	1,371 (72.4)	1,225	146	0.38 [c]
Yes	522 (27.6)	459	63	
Exercise				
≥ 1 times per week	436 (23.0)	399	37	0.05 [c]
< 1 times per week	1,457 (77.0)	1,285	172	
Depressive symptoms (Two item of PHQ-9 [b])				
No	1,475 (77.9)	1,335	140	<0.001 [c]
Yes	418 (22.1)	349	69	

[a] Frequency drinking was defined as "almost every day" drinking.
[b] Feeling down, depressed, or hopeless. Little interest or pleasure in doing things
[c] chi-square test
[d] t test
[e] Fisher's exact test
PHQ-9: Patient Health Questionnaire

at work. Depressive symptoms were significantly more prevalent in shift workers.

The mode of sleep duration category was 5-6 hours, independent of long working hours (**Table 2**). There was association between sleep duration (< 5 hours/day vs. ≥ 5 hours/day) and working hours (< 200 hours vs. ≥ 200 hours) ($p < 0.001$, chi-square test).

Unadjusted logistic regression analysis revealed that male gender, shift work, long working hours, short sleep duration, current smoking, and lack of habitual exercise were risk factors for depressive symptoms (**Table 3**). Multiple logistic regression analysis revealed that that male gender, shift work (odds ratio = 2.01, 95% confidence intervals: 1.45-2.79, $p < 0.0001$), long working hours (odds ratio = 1.40, 95% confidence intervals: 1.03-1.89, $p = 0.03$), and short sleep duration (odds ratio = 2.01, 95% confidence intervals: 1.54-2.63, $p < 0.0001$) were independent risk factors for depressive symptoms (**Table 3**).

Shift workers worked only as manufacturers or manual laborers, while daytime workers worked either manufacturing jobs or non-manufacturing jobs. To analyze effects of job type (manufacturing job or not) on depression,

Table 2 Long working hours and sleep duration

		Sleep duration (hours)					
		< 4	4 - 5	5 - 6	6 - 7	≥ 7	Total
Long working hours (hours)	< 200	22	215	**645**	578	153	1,613
	≥ 200	8	72	**136**	57	7	280
	total	30	287	781	635	160	1,893

$p < 0.001$ (chi-square test)
Mode of sleep duration in each long working hours hour bin is presented in bold.
Work more than eight hours per day was defined as long working hours.

Table 3 Risk factors of depressive symptoms

		Unadjusted		Adjusted	
Variable	Categories	Odds Ratio (95% CI)	p-value	Odds Ratio (95% CI)	p-value
Working schedule	Day work *	1.00		1.00	
	Shift work	1.89 (1.38 - 2.57)	<.0001	2.01 (1.45 - 2.79)	< .0001
Working hours	< 200 hours/month *	1.00		1.00	
	≥ 200 hours/month	1.51 (1.13 - 2.01)	.005	1.40 (1.03 - 1.89)	0.03
Sleep duration	≥ 5 hours /night *	1.00		1.00	
	< 5 hours /night	2.11 (1.62 - 2.75)	<.0001	2.01 (1.54 - 2.63)	< .0001
Age	one year increment	0.99 (0.98 - 1.00)	0.18	1.00 (0.99 - 1.01)	0.59
Sex	female *	1.00		1.00	
	male	1.47 (1.12 - 1.93)	.006	1.38 (1.03 - 1.84)	0.03
Current Smoking	No *	1.00		1.00	
	Yes	1.48 (1.17 - 1.87)	.001	1.26 (0.98 - 1.62)	0.07
Exercise	≥ once a week *	1.00		1.00	
	< once a week	1.34 (1.03 - 1.76)	.03	1.26 (0.96 - 1.67)	0.10

* Reference category
Adjusted model included age, sex, current smoking (yes vs. no), frequent drinkers (yes vs. no), exercise (≥ once a week vs. < once a week), working schedule, working hours, and sleep duration.

we compared the prevalence of depressive symptoms according to job types among daytime workers. Prevalence of depressive symptoms with manufacturing and non-manufacturing jobs among daytime workers were 26.4 % and 20.5 %, respectively (p= 0.27, t-test). Thus, we did not analyze job type in the logistic regression models.

Discussion

This study revealed that shift work raised the risk of depressive symptoms independent of short sleep duration and long working hours. Whether manufacturing job or not was not associated with depressive symptoms.

Relationship between shift work and depressive symptoms

Bara et al. reported that men who worked nights for more than four years displayed increased risk of mental health issues, including anxiety/depression, compared with men who had never worked nights, after adjusting for age, marital status, education, and number of years working across six occupational categories [odds ratio (OR) 2.58, 95% confidence interval (95% CI) 1.22-5.48; OR 6.08, 95% CI 2.06-17.92, respectively] [16]. Former or current male shift workers have an increased risk of having depressed mood and depressive disorder [OR 1.39, 95% CI 1.09-1.79 and OR 1.79, 95% CI 1.32-2.42, respectively] when compared with workers who have never done shift work. After correcting for age and education level, however, these factors lost significance [17]. These two studies support our findings that shift work is a risk factor for depression. Their study also demonstrates that shift work is a risk factor for depression independent of short sleep duration and long working

hours.

There have been reports that circadian rhythms affected mood and depressive symptoms. Subjective mood and severity of depressive symptoms were influenced by changes in circadian rhythms[18]. Depression scores were higher after night work than those after day work or during a control day of rest[19].

People engaged in shift and night work are frequently out of phase with society. Shift workers may face difficulties in their social lives because their family members and the social activities of others are arranged in day-oriented rhythms. Consequently, shift work can lead to social marginalization due to the mismatch between the shift workers' time budgets (working hours, commuting, and leisure times) and the complex organization of social activities[20, 21].

Relationship between long working hours and depressive symptoms

Relationship reported between long working hours and depression was inconsistent in previous studies.

Virtanen reported that the risk for major depressive episodes rose with long working hours[22, 23]. In addition, Kleppa et al. reported that working overtime was associated with increased levels of depression[24]. Results of meta-analyses indicated small but statistically significant correlations between psychological ill-health and long working hours[25].

Some studies reported no association, and others reported short working hours are associated with depression. Baldwin et al. reported that extended work hours were associated with social dysfunction, but that depression was not associated with extended hours[26]. Nakata reported no apparent association between long working hours and depression[27]. Tyssen et al. reported that less working hours were independent predictors for suicidal ideation[28].

Confound factors such as job demand[29], sleep duration[30] were suggested.

Relationship between long working hours, short sleep duration and depressive symptoms

Some studies showed that long working hours have an increased risk of depressive symptoms/major depressive episodes, while others reported did not showed association[31].

We found an increased prevalence of depressive symptoms among Japanese workers with a short sleep duration (< 5 hours) and long working hours. Several previous studies have also reported that short sleep duration was associated with increased incidence of depression[32–36]. Some study reported short sleep duration was the risk for depression[37]. Long working hours and short sleep duration have not been analyzed together in one study. This is the first study analyzing both together, reporting both are independent risks for depressive symptoms.

Health care policy of the company

The company in the present study has conducted not only legal periodic medical examinations, but also additional medical examinations, such as abdominal ultrasound tests and fundus copy, to improve health of the employees.

In Japan, working hours of more than 40 hours per week are designated as overtime work. Workers who had 100 hours of overtime work in a month, or who had 80 hours of overtime work in average can undergo face-to-face medical interview by doctors. In this company, all workers who overworked 80 hours or more and shift-workers who overworked 45 hours or more must undergo face-to-face interview. No workers reported overtime work of 100 hours or more.

Health care plan

We found that short sleep duration is a risk factor for depression in this study. We plan to utilize the outcome of this study to minimize health problem for workers. We plan to start sleep education programs, and group cognitive-behavioral therapy for insomnia and depression to this population. This study suggests that shift workers are more vulnerable to depression. Thus, their programs will put emphasis on the shift workers.

Limitations of this study

The present study has the following limitations. First, this study was conducted in only one pharmaceutical company in Japan. The results cannot be overgeneralized. Second, this is a cross-sectional study, and therefore cannot clarify causal relationships among factors. Third, sleep duration data were obtained from self-reports, and not from objective sleep duration measurements such as actigraphy or polysomnography. Fourth, we only analyzed short sleep duration and not extended sleep duration. Finally, we analyzed "depressive symptoms" in terms of two items and not from structured interview or from questionnaires with more items.

This is the first study suggesting that shift work and long working hours are risk factors for depressive

symptoms independent of short sleep duration. We are planning to develop new interventions and/or education programs to extend sleep duration and to improve sleep quality to prevent depressive symptoms, especially for shift workers. With these, we would like to improve work environments, for example to establish well-balanced shift and holyday schedules. Eventually, these efforts may contribute to work-life balance and welfare of the workers.

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Conflict of interest

YN is employee of the company. HK's laboratory is supported by donation from Philips Respironics GK, Takeda Pharmaceutical Company Limited, Sanofi K.K., and TEIJIN Limited to Shiga university of Medical Science and that he is a member of the Advisory Board for MSD K.K. and Sleepwell; doing collaboration work with TEIJIN Limited and Mizuno Corporation.

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